Biotechnology--Diversification, and the Food Industry

by

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I congratulate this society for coming up with the overall theme of "New Markets, New Marketing and New Thinking." It strikes a chord with me, since the Granada Corporation has been built around this very theme. It is, therefore, a pleasure for me to be a part of this conference and to contribute to discussions on "Applications of New Technology."

A goal of the Granada Corporation is to provide leading edge technology to the food industry. My topic of "Biotechnology--Diversification, and the Food Industry" allows me to discuss our own activities, but I will also make some general comments about the emerging technologies, which are now referred to as biotechnology. I will include discussion about trends in the food industry, both from integration and distribution standpoints.

The past two decades of activity in research and technical development in the food industry have been marked by work on food components (especially proteins), energy concerns, and quality and safety issues. In contrast, the coming decade will probably be remembered as the era of biotechnology. It is worth our time to discuss briefly what biotechnology encompasses to understand the significance of this statement.

The Office of Technology Assessment (OTA) uses two definitions of biotechnology. The first broad definition is any technique that uses living organisms (or parts of organisms) to make or modify products, to improve plants or animals, or to develop microorganisms for specific use. This definition encompasses traditional technologies such as fermentation that have been used to produce food and food ingredients for thousands of years. To differentiate between those traditional approaches and the new techniques now coming into being, OTA formulated in 1988 a new definition for biotechnology. It is: *The industrial use of recombinant DNA, cell fusion, and novel bioprocessing techniques.* This is the biotechnology that I wish to discuss. It focuses our attention on the industrial uses of scientific discoveries arising from the new fields of molecular genetics and molecular biology, which are now often lumped under the heading of genetic engineering.

There are at least four ways in which biotechnology will have an impact on the food industry:

- By lowering production costs for crops and animals that are the raw materials for the food industry.
- By creating market-targeted commodities rather than undifferentiated raw materials.
- By creating new enzymes or sources of enzymes which can be used in food processing.
- By providing new ways to remove waste products of the food processing industry.

Production of Lower Cost Crops and Animals

There is now extensive research in universities and industry directed to the creation of genetically engineered crop plants. Perhaps the most exciting are disease-resistant and insect-resistant crops that will give higher yields without use of expensive pesticides. These new crops will enter our food supply chain by the mid 1990s. Equally exciting research is under way with animals. Our research at Granada, in conjunction with several universities, has resulted in the commercialization of embryo

transfer. In other related phases of animal improvement, biotechnology is being used to create new diagnostics and vaccines for improved animal health. There will also be the possibility of creating disease-resistant animals via directed genetic improvement.

Another aspect of animal research involves using biotechnology for improving growth rates. In dairy cattle, for example, the administration of a bovine growth hormone has resulted in increases of milk production of 15 to 40 percent, while requiring only small increases in feed consumption. Successful incorporation and expression of the growth hormone gene in laboratory mammals suggests that it may be possible to use related techniques to increase the efficiency of production by increasing the growth rate of food animal species.

Creation of Market-Targeted Commodities

In the past, the food processor has had little opportunity to select for differences in his raw materials. There have been few ways to make unique corn flake breakfast cereals, for instance, since the starting grain material was essentially generic. Processors and distributors have had to rely on packaging, advertising and price to influence the consumer. But with the new tools of biotechnology, there are now opportunities to genetically design a new type of grain--one that might have different nutritional components or even different flavoring.

It is important that we relate these scientific possibilities to the food industry. It is intriguing that food marketing trends are rapidly changing as the new biotechnology tools are appearing. In the 1980s, two factors have been dominant in influencing food markets. These are consumers' demands for convenience, and products good for their health. By modifying food materials to create unique traits in either area, a marketing advantage can be created.

There now are several examples of food marketing trends in response to consumer health demands. The switch to lean beef immediately comes to mind. As consumers ask for less fat and cholesterol, the beef industry has responded by changing animal feeding patterns and by more extensive trimming of the carcass. Coming behind this is a major push at changing the genetics of our beef cattle to select for leaner animals. Granada has been a leader in this area.

In addition, some university research is targeting longer term biotechnology opportunities to improve production animals. For example, Texas A&M University has a new initiative to create an Institute for Biosciences and Technology here in Houston. This Institute will feature comparative animal genetics studies to create a forefront body of knowledge in molecular biology. A spin-off of this research will be the technological tools needed for creation of market-targeted animals selected for improved human nutrition.

Enzymes

The food processing industry is currently the largest consumer of industrial enzymes, making up about 40 percent of a $400 million market. Enzymes are added during food processing to control texture or appearance, enhance nutritional value, and generate desirable flavors and aromas. Future application of biotechnology will involve protein engineering--changing the primary structure of an enzyme. Such changes may alter target specificity, acidic condition, or thermostability. Protein engineering can be used to "tailor-make" new proteins to function best in commercial food processing systems. Let me give an example. The current trend toward a more health- and nutrition-conscious lifestyle has encouraged the development of low calorie foods. The non-nutritive sweetener market has been predicted to reach $500 million by year 2000. Scientists have cloned the gene for a small protein that tastes much sweeter than sugar, but has few calories. This product can be produced by fermentation, or perhaps even directly in some plants. This will offer new opportunities for non-calorie sweeteners. We will also see industrial enzymes produced to convert saturated to unsaturated fatty acids for "heart-healthy" foods.

By-products and Waste Materials

Enzymatic treatment of food processing waste streams could produce materials readily metabolized by microorganisms genetically engineered to produce antibiotics, hormones, or peptides of interest to the pharmaceutical or chemical industries. In the future, environmental and economic concerns will necessitate a reduction of food processing waste, more efficient use of raw materials, and the processing of food residuals to new products that have value. This is a new area of interest for biotechnologists, but one that will grow.

Conclusion

Let me now turn to the structure of the food industry. As I look at the use of biotechnology, the most obvious observation is that the industry will take on a new look. I would like to spend a little time discussing this as it relates to the diversification of our industry, and what some of these changes will mean as far as the distribution segment of the industry is concerned.

First, the incorporation of biotechnology into the food industry will bring about serious and significant changes. As I think about the sub-theme of this presentation--*Applications of New Technology*--I cannot resist the temptation to warn that if you don't incorporate the *new thinking* portion of your overall theme, you might not have to worry about the *new markets* concept.

We are involved in an exciting time in our industry. The impact of biotechnology is only one of many parts of the changing dynamics we face, but it is a major factor which we have a chance to influence. Granada has taken the opportunity to participate in research in this area, to support academic studies that will provide new tools for biotechnology, and to encourage educational efforts which allow broad public understanding of this emerging field. We must work together to expand these efforts to maintain Texas and U.S. leadership in the food distribution industry.